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ABSTRACT

Influenced by generative and intentional learning environment strategies and tools, a World Wide Web-based tool has been developed to empower learners to build their own Web-based Performance Support System (WPSS) to support learning, professional development, and performance within a domain. Enabling learners to develop their own WPSS accomplishes two goals: people learn about the domain while they are locating, evaluating, and organizing resources to support their work activities and/or intentional learning activities; and once the WPSS is completed it can be used to support performance and further professional development while working in that domain. In this way, a WPSS not only enables learners to build a learning and performance resource that will provide them with immediate support and guidance, it also helps them develop structure, strategies, and skills for subsequent lifelong learning activities. Topics discussed in this paper include: (1) lifelong learning defined, including metacognition and self-directedness; (2) organizations and professional development, including conventional training and electronic performance support systems solutions; (3) instructional methodologies for developing lifelong learning skills, including generative and intentional learning environments; and (4) learner-centered WPSSs, including an overview of development tool components and examples of the WPSS in use. Two figures illustrate sample WPSS categories and a threaded discussion. (Author/DLS)

Encouraging Lifelong Learning with Learner-constructed Web-based Performance Support Systems

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Abstract: Influenced by generative and intentional learning environment strategies and tools, a Web-based tool has been developed to empower learners to build their own Web-based Performance Support Systems (WPSS) to support their learning, professional development, and performance within a domain. Enabling learners to develop their own WPSS accomplishes two goals: (1) people learn about the domain while they are locating, evaluating, and organizing resources to support their work activities and/or their intentional learning activities; and (2) once the WPSS is completed it can be used to support performance and further professional development while working in that domain. In this way, the WPSS not only enables learners to build a learning and performance resource that will provide them with immediate support and guidance, but also helps them develop structure, strategies, and skills for subsequent lifelong learning activities.

In a climate of rapid change, increasing innovation, emerging technologies, and proliferating knowledge, lifelong learning is a necessary professional development objective. In order to keep current, people have to be willing and able to continually "retool" their knowledge and skill base. The need to be a continuous learner is especially apparent in domains influenced by scientific and technological advances; these advances cause knowledge and skills to become obsolete overnight. Yet, employers need personnel who possess contemporary skills and knowledge, and are willing and able to proactively update their abilities to meet the ever-changing needs of the organization. Employees who are able to keep up with the information explosion are valuable assets; employees who fail to "grow with the flow" are restructured out of their positions. Therefore, lifelong learning is essential to staying current, competitive, productive, and innovative in today's workplace, and therefore employed and in-demand.

Following the prescriptions of the intentional learning methodology which promotes the development of metacognitive and self-directed learning skills, a web-based development tool was created. This tool was designed to help people generate their own, individualized web-based performance support systems (WPSS) to address the concerns described above by encouraging and providing a supportive structure for lifelong learning activities.

Lifelong Learning Defined

The knowledge explosion requires professionals to engage in lifelong learning if they intend to stay current — let alone evolve, advance, and remain competitive — in their profession. Therefore, lifelong-learning skill development is imperative if people are expected to learn over the full expanse of their professional lives. Unfortunately, some of the people that most need lifelong learning skills — those with careers in ill-structured, complex professions — are not developing them during their formal education. Regarding the lack of lifelong-learning skill development in schools, Walton and Matthews [Walton & Matthews 1989] state, "Some [professionals] from...schools with the usual type of curriculum behave as if they had been immunized against further learning, and many [professionals] often do not continue to learn sufficiently." In order to better prepare people for lifelong learning, learners must be exposed to learning activities that require them to take on and develop many of the responsibilities normally afforded to educators. "We teach most effectively when we help our students learn how to learn...not what to think and make and do in [the current year]; but how to think and how to learn for those years of life and profession than lie ahead"

[Nash 1994]. To achieve this requires moving away from a view of learning that is controlled outside the individual — by a teacher, trainer, instructional designer, or subject matter expert — to a view of learning that is internally controlled by the individual [Overly et al. 1980]. The ability to engage in lifelong learning, therefore, is based on the development, and subsequent successful application, of two skill areas: metacognition and self-directedness.

Metacognition

Von Wright [Von Wright 1992] defines metacognitive skills as "the steps that people take to regulate and modify the progress of their cognitive activity: to learn such skills is to acquire procedures which regulate cognitive processes." Glaser [Glaser 1984] describes metacognitive or self-regulatory skills as knowing what one knows and does not know, predicting outcomes, planning ahead, efficiently apportioning time and cognitive resources, and monitoring one's efforts to solve a problem or learn. Metacognitive skills include taking conscious control of learning, planning and selecting strategies, monitoring the progress of learning, correcting errors, analyzing the effectiveness of learning strategies, and changing learning behaviors and strategies when necessary [Ridley, Schutz, Glanz, & Weinstein 1992]. Because metacognition involves these self-regulatory skills, it can have a positive impact on problem solving ability and the transfer of knowledge across domains and tasks if developed during instruction [Bereiter & Scardamalia 1985] [Bransford et al. 1986]. In fact, if not developed, students have difficulty recognizing when they have failed to adequately meet learning goals or complete tasks [Bransford et al. 1986]. Since these are skills utilized by successful practitioners and experts [Chi, Feltovich, & Glaser 1981] [Bransford et al. 1986], adequately developed metacognitive ability is needed in order to engage in effective problem solving and reasoning activities.

Self-directedness

> To be successful, students must develop the self directed learning skills needed [within the domain]. They must be able to develop strategies for identifying learning issues and locating, evaluating, and learning from resources relevant to that issue. [Savery & Duffy 1995]

The domain of medicine provides a perfect example of self-directedness. When dealing with real patients, the doctor has to begin assessing the patient's condition before having all of the data necessary to evaluate, diagnose, and treat the patient. Characteristically, the patient provides the doctor with fragments of information ("My stomach hurts. I can't hold any food down. No one else in my family is experiencing any problems."). The rest of the information needed to solve the patient's problem comes from the study of a variety of other resources: patient and family history, laboratory results, x-rays, other doctors' opinions, past experiences, similar cases in the case file, and current research findings on new diagnostic and treatment procedures. The doctor has to determine what information is needed, what resource should be used to acquire the information needed, how to use the resource effectively, how to come to terms with opposing or contradictory information, and how to apply the information acquired to the problem to achieve a solution for the patient. These skills are described as "self-directed learning skills" [Barrows 1985] [Barrows 1986]. Barrows [Barrows 1995] defines the process of self-directed learning as utilizing the following skills to solve a problem or fulfill a learning requirement:

- the ability to identify and define a problem/learning need;
- the ability to identify, find, use, and critique resources for solving the problem or meeting the learning requirement;
- the ability to capture and apply information from resources to the problem or learning need; and
- the ability to critique information, skills, and processes used to solve the problem or meet the learning requirement.

Staying abreast of new innovations, research, techniques, and information is a prerequisite for successful decision-making and problem-solving on-the-job. Therefore, professionals need to develop lifelong learning skills, specifically metacognitive and self-directed learning skills, if they intend to stay current in their fields.

Organizations and Professional Development

Although employees' ability to engage in lifelong learning has a direct impact on an organization's effectiveness in today's ever-changing marketplace, the development of the skills needed to engage in perpetual learning activities has been neglected by many employers. Unfortunately, many organization's rely on short-term solutions, such as conventional training and performance support tools.

The Conventional Training Solution

How are professional development activities typically addressed? We often see trainers imparting knowledge and procedures to trainees using canned, inflexible instructional materials which often do not reflect the true complexity or the current reality of an ever-changing work environment. [Unfortunately, this is the case whether we are describing an instructor-led environment, computer-based training (CBT), or Web-based training (WBT) (which is often just CBT repurposed for the Web).] After the training activity is over, employees struggle with applying what they learned from their training experience to the demands of their jobs. Not only did the conventional training solution not accurately represent the on-the-job performance requirements, but it did not prepare the employees to:

- transfer the knowledge and skills to their specific job requirements,
- extend the knowledge and skills presented during training to address increasingly complex job requirements, or
- update the knowledge and skills presented during training when their job requirements change or the knowledge and skills change.

In other words, what is missing from the equation is the development of domain-specific lifelong learning skills so those employees can actively transfer, extend, and update the knowledge and skills acquired during training. So, employers have looked for other professional development solutions that address this problem. One solution that has presented itself is electronic performance support systems (EPSS).

The Electronic Performance Support Systems Solution

Although redefined and revised over the last few years, the term electronic performance support system refers to an integrated database of information, tools, learning experiences, resources, and guidance/advise designed to help people learn how to perform a task just-in-time or on-demand with limited conventional training support [Gery 1991] [Raybould 1995]. Addressing the failings of conventional training, electronic performance support systems have been utilized as alternatives and supplements for conventional training solutions.

However, the problem with conventional training is also, in part, the problem with EPSS. EPSS products are typically developed by instructional designers or performance technologists working with content experts. All of the tools, references, job aids, and tutorials are created to meet the general and generic needs of all the individuals who will access the EPSS; assuming that everyone who needs to access the EPSS has the same performance issues, learning needs, and learning preferences, EPSS limits individualization. In addition, like with conventional training solutions, all of the higher-order thinking, problem-solving, and decision-making that goes into creating the "content" of an EPSS — all of the activity that helps people develop domain-specific lifelong learning skills — is done by the development team. So, again, the issues of transfer, extension, and updating are not effectively addressed by EPSS.

Instructional Methodologies for Developing Lifelong Learning Skills

In order to develop lifelong learning skills, the learners — as opposed to the instructor or development team — need to be directing and driving the learning process and activities based on their learning and performance needs. Two instructional methodologies that specifically address the development of lifelong learning skills are generative learning and intentional learning.

Generative Learning Environments

Instead of the accessing information from the system that was input by someone besides themselves (such as a teacher, subject matter expert, or instructional designer), a generative learning environment requires students — individually and collaboratively — to be responsible for creating, elaborating, and representing domain knowledge in an organized manner [Cognition and Technology Group at Vanderbilt 1992] [Hannafin 1992] Scardamalia et al. 1989] [Scardamalia & Bereiter 1991]. Some generative learning environments provide students with a context or situation requiring them to take action (e.g., a problem that needs to be solved or a case that needs to be analyzed). Other types of generative environments require students to determine what it is about a particular content area they wish to know, and then take responsibility for answering their own questions through research and synthesis and representing the acquired knowledge in an organized and accessible way. It is through this process of "generating" knowledge, instead of passively receiving information, that help learners develop structure, strategies, and habit for lifelong learning.

Generative learning environments require students to take responsibility for determining what it is about a particular domain they need to know, and then direct their activities accordingly to effectively research, synthesize, and present their findings. Schank and Jona [Shank & Jona 1991] describe a generative learning environment in their discussion on the research method of teaching. Under the research method of teaching, students are asked to research a particular topic and then present their results to others (the class, a collaborative group, etc.). In this way, students are taking over the responsibility of information gathering and synthesis and dissemination/presentation from the teacher.

For this teaching method to lead to successful learning, students need to be allowed to select their own topics to research and report on, so that they have a real interest in proceeding with the assignment and have more control over their learning. Because the learning is student-directed, where each student makes choices and takes responsibility for those choices, the learning is more meaningful; "...in general, material that is organized in terms of a person's own interests and cognitive structures is material that has the best chance of being accessible in memory." [Bruner 1961]. In addition, because students are responsible for selecting a topic, developing a question to research, making decisions about how to gather information, analyzing and synthesizing information, etc., they are engaging in activities that help to develop high-level thinking and problem solving abilities.

Intentional Learning Environments

Intentional learning refers to the "cognitive processes that have learning as a goal rather than an incidental outcome" [Bereiter & Scardamalia 1989]. When employed in a learning environment, intentional learning encourages students to take "an intentional stance toward cognition" [Scardamalia & Bereiter 1991], which means that learners must learn how to monitor and be aware of their own learning processes, and take responsibility for pursuing desired and/or required learning outcomes. Intentional learning is learning that is actively pursued by and controlled by the learner [Resnick 1989]. Palincsar and Klenk [Palincsar & Klenk 1992] describe intentional learning as an achievement resulting from the learner's purposeful, effortful, self-regulated, and active engagement. By encouraging students to take "an intentional stance toward cognition", intentional learning helps students learn how to not only monitor and be aware of their own thinking and learning processes (i.e., metacognitive skills), but also to take responsibility for pursuing individually-determined learning goals (i.e., self-directed learning) — the "cognitive processes that have learning as a goal rather than an incidental outcome" [Bereiter & Scardamalia 1989].

An example of a computer-mediated, intentional learning environment is the Computer-Supported Intentional learning Environment (CSILE). The goal of CSILE is to support students in the purposeful, intentional processing of information [Scardamalia et al. 1989] [Scardamalia & Bereiter 1991]. Using CSILE, students are supported in the construction of a shared knowledge base, representing and organized the domain

in ways that can be understood and utilized by others interested in the domain. In other words, instead of accessing information from a pre-existing database that was structured, organized, and filled in by someone else, students engaged in CSILE create their own knowledge base based on what they want to learn and on how they want to structure and organize the information to be an effective resource for other learners.

Generative and intentional learning environments encourage students to construct their own meaning, perception, understanding, and knowledge. Through the process of creating, elaborating, and representing their own knowledge, these learning environments utilize instructional strategies such as collaboration, knowledge construction, reflection, and self-directedness to promote the development of lifelong learning skills and strategies, as well as a predisposition to lifelong learning activities.

Learner-center, Web-based Performance Support Systems

Influenced by generative and intentional learning methodologies as well as the EPSS technology, I have developed a Web-based tool empowers learners to build their own Web-based Performance Support Systems (WPSS) to support their learning, professional development, and performance within specific domains. Similar to electronic performance support systems (EPSS), a WPSS uses the Web to provide on-demand access to integrated information, guidance, advice, assistance, training, and tools to enable high-level job performance. In fact, using the Web to create performance support systems is a perfect fit because the Web is actively used by professionals as a forum for the distribution of current and up-to-date references, instruction, and guidance. By
creating a structure that supports individualized and collaborative knowledge building by the people who will actually be using the knowledge, the higher-order thinking, problem-solving, and decision-making regarding the selection and utilization of appropriate learning materials and performance support is done by those who can get the most out of the process. Enabling employees to utilize an easy-to-use tool to develop their own WPSS accomplishes two goals:

1. they learn about the domain while they are locating, evaluating (which requires utilization of resources), and organizing resources to support their job performance activities and/or their generative and intentional learning activities; and
2. once the WPSS is completed it can be used to support performance and further professional development while working in that domain.

In this way, the WPSS not only enables learners to build a learning and performance resource that will provide them with immediate support and guidance, but also helps them develop structure, strategies, and skills for subsequent lifelong learning activities.

Overview of WPSS Development Tool Components

The WPSS development tool helps employees — collaboratively and as individuals — organize, assess, and utilize Web-based resources. In order to build an effective WPSS, the development tool enables employees to organize Web resources into a variety of self-determined categories. Categories may include:

- cue cards: brief definitions, reminders, directives, job aids, best practices
- computer-based instruction: tutorials, case studies, practice activities
- wizards: intelligent demonstration/application functions; assistance
- coaches: response sensitive correction and feedback
- mentors: individualized responses to questions from experts in the field
- practitioner forum: access to other practitioners in the field
- examples
- tools

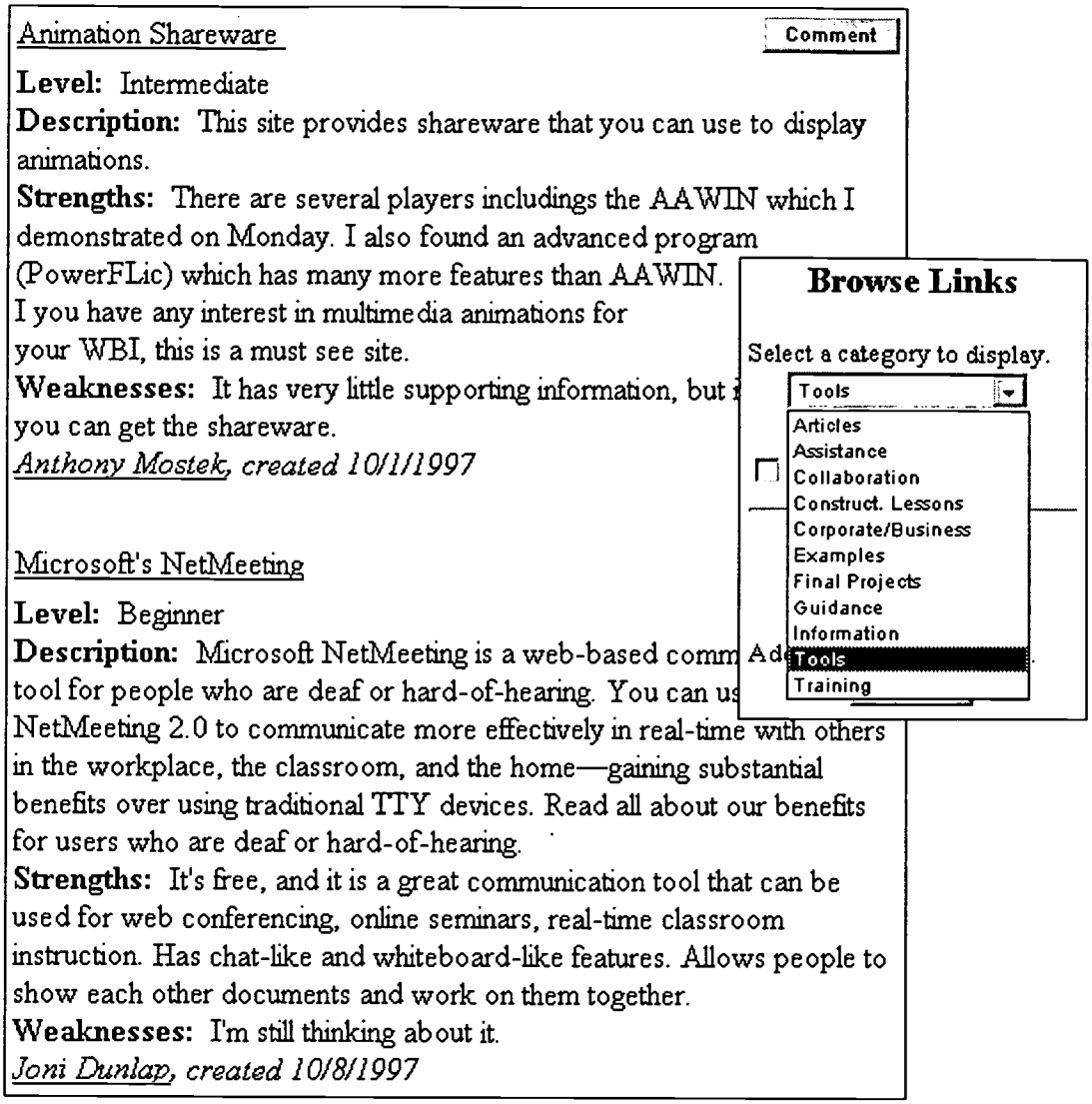

Figure 1: Sample categories and corresponding entries

In order to build a WPSS that meet individualize, specific learning and job performance needs, employees engage in a number of generative and intentional learning activities including:

- determining their learning needs and goals
- developing a plan for action for finding resources to help fulfill those goals
- researching Web resources that meet the appropriate needs
- utilizing Web resources in order to evaluate usefulness, difficulty level, strengths and weaknesses
- updating links to Web resources when appropriate
- responding to other learners' comments regarding WPSS contributions
- developing Web resources via HTML pages and threaded discussion forums

In other words, employees practice and develop the very skills and strategies needed to engage in lifelong learning activities while they are learning domain-specific content and skills needed for their jobs.

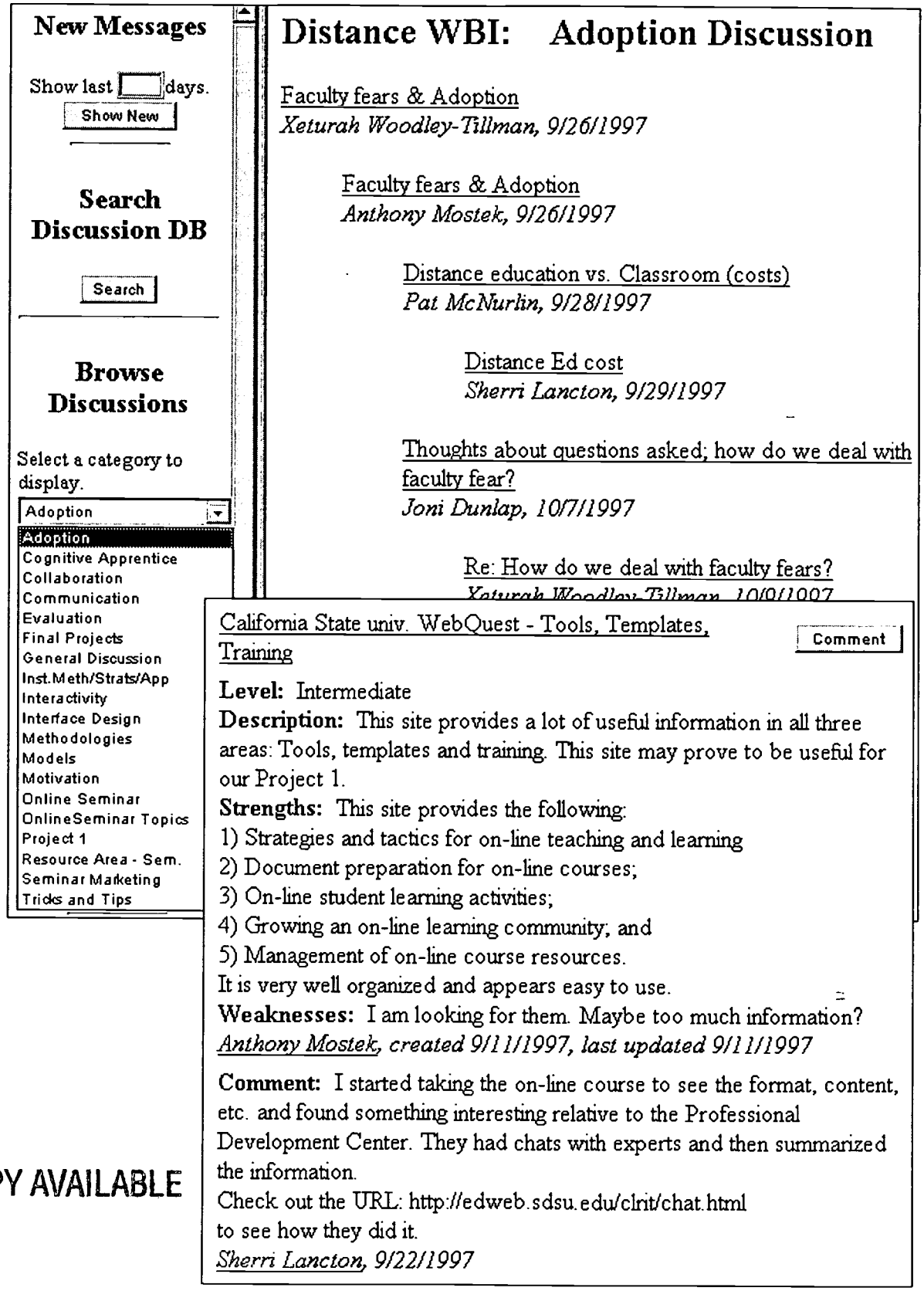

Figure 2: Example of a threaded discussion and commenting on others' contributions

Examples of the WPSS in Use

Although still in a formative stage with enhancements being added all the time, there are a number of examples of the WPSS tool in action. These WPSS examples can be viewed for examination purposes only via the following URLs:

- Domain: Designing Distance Learning for the WWW
  http://www.cudenver.edu/~jdunlap/wpss.cgi/5990
- Domain: Multimedia Authoring with HTML
  http://www.cudenver.edu/~jdunlap/wpss.cgi/5600
- Domain: C++ Programming
  http://www.cudenver.edu/~jdunlap/wpss.cgi/cplpl

To experiment with the tool, access to a sample site is provided at: http://www.cudenver.edu/~jdunlap/wpss.html

[Note: In order for the WPSS to function properly, your browser must accept cookies and have JavaScript enabled.]

Conclusion

Because lifelong learning is now such a critical success factor for professionals in business and industry, learning environments that help promote the development of lifelong learning skills and strategies are in high demand. Influenced by generative and intentional learning environments, a Web-based development tool was designed to enable employees to develop their own Web-based performance support systems. The activity of building a WPSS helps employees learn about a domain, construct a knowledge base to support their future performance and professional development in that domain, and develop the skills, strategies , and structure needed to engage in the type of lifelong learning activities that will help them stay current in their professions.

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